When Uncertainty is Likely to Trigger Change in a Decision? An Evolving Research Theme in the SECC

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Uncertainty in agricultural responses using climate forecast

Climate variability associated with ENSO is now predictable. This suggests a potential to tailor agricultural management to benefit from climate variability. Deterministic/stochastic crop model is recognized method to address climate sensitivities and are used routinely in decision/management formulation.

Why uncertainty in a crop model matters?

1. Most times, the only uncertainty considered is climate uncertainty.
2. Quantification of uncertainty is required as input to any decision analysis
3. Uncertainty analysis should play a diagnostic role in an assessment to highlight factors whose uncertainty is pivotal in determining actions.
4. We have not put enough efforts to document impacts of uncertainty on decisions.

Ho: **Uncertainties add another level of complexity in decision making.**

How uncertainty is currently handled in Ag Models?

- Field calibration/validation
- Spatial / temporal probability inputs

Examples within the SECC:

- ✓ Drought mitigation
- ✓ Crop mix
- ✓ Risk management/Insurance Products
- ✓ Environmental protection

4-sources of uncertainties

1. Model
2. Downscaling climate forecast
3. Validity of assumptions
4. Scaling-up/ aggregation

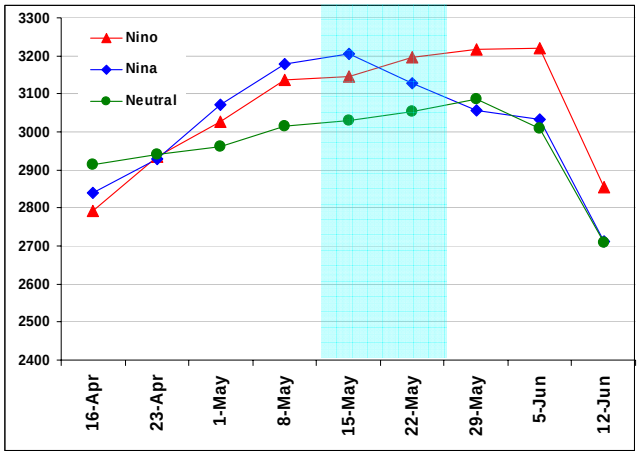
Case Study:

Sensitivity of peanut yields, a major cash crop, on a North Florida peanut farm in Jackson County, which has been the highest peanut growing county in the state

65-years climate data suggests that **higher rainfall** and **cooler temperatures** are observed during El Nino (14 years), with the **opposite being true** in La Nina (16 years).

Virtual simulations used the PNUT-GRO, a well calibrated and tested simulator, using current management practices in the region for varieties, fertilization and sowing dates (16 April to 12 June at weekly interval).

1. The case study shows potential for enhancing peanut yields on average about 4% by tailoring planting dates to expected ENSO conditions.
2. Tailored management calls for **later** planting during an El Nino, and **earlier** planting in La Nina (Figure on the right)



Sources of Uncertainty: **1. Model errors**

The assumed form of model is likely to have substantial effect on the results of analysis.

Methods for dealing with uncertainty on decision making

a. Hybrid model (s)
b. Agricultural Response Team - an inter-disciplinary or agency, effort to effectively communicating forecast driven decisions and planning for agriculturally-related activities
c. Participatory development and evaluation of forecast product (i.e. Australian example)

Sources of Uncertainty: 2. Downscaling forecast

Variability in ENSO signal

Strength of ENSO

Success in long-lead seasonal forecasts has led to, often unrealistic expectations. The fact remains that climate predictions have modest skill, and in many instances no or marginal skill, even with strong ENSO signals.

Methods for dealing with uncertainty on decision making

a. Enhance reliability of coupled ocean-atmospheric models
b. Integrated assessment with coupled ocean-atmospheric & crop models

Sources of Uncertainty: 3. Error of judgment (assumptions)

Value of climate forecast to users

Within in the SECC and elsewhere, it has been shown that climate forecasts have tangible economic value for users.

Assumptions/hypothesis

1. The user must exercise the prescribed process over many years in a disciplined and consistent manner.
2. The user's decision-making environment remains static for entire period,
3. The user does not abandon use of the forecast, even the forecast was wrong in several successive years.

Let's see what happens when a grower in Jackson county modifies planting date according to ENSO phase forecast we developed earlier……

Validity of assumptions

Recommendation: Ideal planting window: Mid-May

Sources of Uncertainty: 3. Error of judgment (measurement)

Methods for dealing with the psychology of users

a. How resilient is the user? – risk aversion/utility theory?
b. How many times, before the user abandons use of forecast?
c. Take into account these uncertainties to provide a sense of what skill levels are necessary to increase chance that even relatively short sequence of decisions will be of value.

Sources of Uncertainty: 4. Scaling-up / Aggregation with plot-scale models

There are clear advantages to adopting plot-scale models to regional scale, as recommendations and policies are generally implemented at this scale.

SECC – wants to produce forecasts of agricultural responses at watershed and state scales using climate forecasts, and need to know the forecast uncertainty

In applying a field scale model over space may require perfect aggregation of effects of all possible input combinations over geographic space and probability space.

What sort of uncertainties is introduced by this mismatch of scales?

Ho: The use of probabilistic inputs will underestimate risks that producers face!

Deterministic models with probabilistic inputs will underestimate risks and should be a reason for caution in using such deterministic analysis.

Summary

4-types of uncertainties have been identified

1. Model errors
2. Variability in ENSO
3. Measurement errors
4. Scaling-up/ aggregation

Likely Activities: Methodology development for routine applications to identify high impact areas for uncertainty

1. Uncertainty can affect decisions.
2. Recognizing impacts require that uncertainty analysis should be an integral part of forecast recommendation development process
3. It should be probabilistic, as actions may differ from those taken when only the best estimates are provided to decision makers
4. Past SECC studies will be used to prioritize studies

Key References

SECC case studies

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